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AGRICULTURAL JOURNAL

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EDITORIAL.

IT is unfortunate that a higher proportion of original articles cannot be obtained for inclusion in issues of the Journal at present, owing to the fact that the effective scientific staff of the Department is depleted. The Government Entomologist is in Trinidad on a special mission; the Government Mycologist is on leave; the new Government Chemist has only just assumed duty and but one Veterinary Officer is in the Colony.

In recent issues of contemporary Journals a number of valuable articles, having a direct bearing on Fijian agricultural conditions, have appeared and these have been freely drawn upon for our Journal. It is hoped that next year arrangements can be made for the inclusion of a greater number of original articles by members of the staff.

Fiji Agricultural Show.—The Annual Show held by the Fiji Show Association took place in Suva on October 14th and 15th. On the whole it was a very creditable exhibition, but suffered from poor display in the agricultural sections, and insufficient lighting throughout both the Customs sheds in which the Show was held. The Colony depends entirely upon agriculture for its prosperity and an Annual Show provides an excellent means of fostering the interests of all classes, whether directly concerned in agriculture or not. The Fiji Show Association is to be complimented on the work that it has done in this direction, but is seems that the time is with us when its functions should be extended so that it may become the parent Agricultural Association of the Colony, with which is affiliated such other organisations as the Fiji Planters' Association, the Stock Record Association and any other subsidiary bodies whose interests are concerned with branches of Agricultural effort. The need of a more satisfactory place in which to hold the Annual Show has been felt for some considerable time and progress in the desired direction appears still to be hampered by financial considerations. It is to be hoped that these difficulties will be surmounted in the near future and the Agricultural Organisations of the Colony placed upon a sounder basis.

Fruit Production.—The banana industry suffered a severe setback by the serious extension of ravages due to the root borer *Cosmopolites sordidus*, and this has been reflected for a considerable period by the reduction in exports of fruit to New Zealand. It is interesting to be able to record that a method for destroying the pest and its eggs in suckers to be used for planting has been devised by Mr. H. W. Simmonds, Government Entomologist, and so far as can be judged from the results of earlier experiments, gives promise of success when applied on an extended scale. The method briefly is to immerse the suckers to about four inches above the corm in water for a period of 21 days. To test this method in the field, arrange-

ments have been made for the acquirement of demonstration plots in the principal banana producing areas and these will shortly be planted out with suckers treated in the manner prescribed.

Complaints have been received from merchants in New Zealand in regard to the quality of the bananas supplied from Fiji and it appears that some exporters have not taken sufficient care to see that their fruit was carefully selected and properly packed. Complaints regarding small, inferior, and ripe fruit in the middle of cases of apparently satisfactory fruit reflects very badly upon the banana exporters of Fiji. To maintain and develop our position in the New Zealand fruit market demands the careful attention of everybody connected with the fruit industry. It is essential to maintain a standard—as high a standard as possible certainly—but nevertheless there must be a standard. Shady practices of the nature mentioned discredit not only the exporters immediately responsible but those who endeavour conscientiously to maintain a uniform and satisfactory standard of quality. Instructions have now been issued that the Fruit Export regulations are to be strictly enforced and if exporters suffer thereby it can only be attributed to their own fault.

Fiji Live Stock Record Association.—At a meeting of representative stock owners held in the office of the Department of Agriculture during October, it was agreed that the Fiji Live Stock Record Association had never functioned properly and that it should be re-formed. A new Board of Directors was appointed and a number of alterations to existing regulations suggested. A few days later, the Board of Directors met and agreed upon certain amendments to the regulations which were submitted for approval by His Excellency the Acting Governor in Council. The amended Regulations have now been sanctioned and are published for general information in this issue of the Journal. Sanction has been given for the use of the Journal as the official organ of the Association. In it will be published records of meetings, a list of members, and the names of owners of animals registered in the Herd Book of the Association. It is to be hoped that the re-formed Association will attract members from the agricultural community directly interested in stock, and that it will prove to be an active and effective body. The Department of Agriculture will give every possible assistance in the conduct of the affairs of the Association and adequate publicity through the medium of this Journal is assured. It remains for stock owners to signify their approval to the objects for which this Association has been formed and enroll themselves as members. The small subscription and fees for registration are such as to impose no hardship upon any stock owner who wishes to join. Forms of application for membership can be obtained from the Secretary, Fiji Live Stock Record Association, Department of Agriculture, Suva.

Agricultural Legislation.—During the recent session of Legislative Council a new Ordinance entitled the Noxious Weeds and Diseases of Plants Ordinance passed all its stages. The object of this is to replace three older Ordinances, the Diseases of Plants Ordinance 1913, the Noogoora Burr Ordinance 1919, and the Diseases of Plants Amendment Ordinance 1926. As stated in the explanation of the draft Bill the principal reasons for the introduction of the new measure are to prohibit the importation of plants which may be injurious and to prohibit the planting of land declared to be infected with plant diseases. The measure is intended to be an additional means of protecting agricultural interests in the Colony against the spread of disease and the danger attendant upon uncontrolled growth of

noxious weeds. For the time being existing Regulations, in so far as they apply, will remain in force, but it is hoped that new Regulations will be promulgated at an early date.

At the same session of Legislative Council it was agreed that Government should continue the present control of the Tailevu Dairy Factory until the end of 1930. Under the system of management introduced in 1928 the factory has proved to be a sound commercial undertaking. It has accumulated quite substantial profits which are held on account of the suppliers of butter fat and which form the nucleus of a fund to provide capital for the formation of a Co-operative Company by the Tailevu settlers at a later date. The view was expressed in Council that it would be better if Government undertook to continue the management of the factory for a greater period than one year, but His Excellency the Acting Governor intimated that he was not prepared to commit the new Governor to a greater extent than appeared to him to be necessary and the adoption of the motion to continue control for a year would not preclude the possibility of control for a further period after 1930. The dairy settlement at Tailevu is assured of Government's sympathetic control for at least another year and an undertaking has been given that nothing will be done to prejudice the interests of the settlers in that area.

Imperial Agricultural Bureaux.—At the Imperial Agricultural Research Conference held in London in 1928 it was recommended that further Agricultural Bureaux be established to act as "effective clearing houses for the interchange of information of value to the Research Officers in agricultural science throughout the various parts of the Empire." Two such Bureaux—the Imperial Bureau of Entomology and the Imperial Bureau of Mycology—have been established for some years and have proved of immense value to Colonial Governments and to the Specialist Officers who have been able to apply to them for advice and information. The new Bureaux comprise the following:—

(1) Soil Science.
(2) Animal Nutrition.
(3) Animal Health.
(4) Animal Genetics.
(5) Agricultural Parasitology.
(6) Plant Genetics for crops other than herbage plants.
(7) Plant Genetics for herbage plants.
(8) Fruit Production.

These will be centered upon established research stations in Great Britain and Officers and Agricultural Departments in the Colonies will now be able readily to obtain information regarding the general progress of scientific research in the subjects in which they are interested. The main functions of each Bureau will be the collection and distribution of information on the particular subject or subjects with which it is concerned.

Official correspondents of the different Bureaux will be appointed from the staffs of Agricultural and other scientific departments throughout the Empire. The duty of such correspondents will be to keep the various Bureaux informed of the progress of research work in the particular subjects in the Colony in which the correspondent is working and make suggestions regarding the work and activity of the Bureau. Quoting from a memorandum on the subject: "It is expected that these correspondents will make it their duty to take a lively interest in the function and work of the Bureau and facilitate its activities in the interests of research workers in the Empire as a whole."

Four, and possibly five of the new Bureaux should prove of considerable value to the Colony of Fiji. These are:—Animal Nutrition, Animal Health, Agricultural Parasitology, Fruit Production, and Soil Science.

Quoting from *Tropical Agriculture*:—"It will be realised no doubt that Bureaux have been primarily designed to supply information to research workers and that the responsibility, therefore, of spreading new information will essentially remain in the hands of the latter. In other words, the Bureaux as a central organisation will act as an Intelligence Service which will supply its information to the research officials of the local teaching Institutions or Agricultural Departments. This information will then be passed on to the local research investigator who will in turn disseminate it amongst the planting community. In the event of information being required the process will merely be reversed. The new Bureaux will naturally have to organise their work on their own lines as the problems to be confronted will vary according to the subjects dealt with. The primary needs, however, of a research officer, will have to be kept well in mind. The existence of the new Bureaux will be amply justified if they can keep him up to date with, preferably, as much original literature as possible on the subject studied, together with translations of the more important works, the crying need at present of numerous investigators; if they can help him to identify and, if necessary, to collect specimens from all parts of the world, and, in short, if they can keep him in touch with the whole realm of his pursuits. The research worker could help, in turn, by supplying the Bureau with a concise account of his own activities, and of any new observations he may have been making. The result of such co-operation has, in the past, been invaluable, and it can only be hoped that such co-operation will continue to exist with the formation of our eight new Imperial Agricultural Bureaux, whose future development will be watched with great interest."

SOME ASPECTS OF RICE CULTURE IN FIJI.

By J. P. Tarby.

A pamphlet received from the Department of Agriculture, United Provinces, India, recommends the drainage of rice fields that are to be puddled and submerged, to promote aeration. Rice has been grown in this Colony for many years and the yield of the crop has appreciably decreased. With a view to improving the present yield, a study of the recommendation as affecting our rice fields is called for and a survey of certain other conditions in local rice culture, would seem opportune.

2. *Drainage of rice fields to promote aeration.*—While the promotion of aeration by drainage is well known and its adoption in submerged rice fields in the United Provinces, India, may be advisable, the necessity for its application to the rice fields in this Colony does not, in my opinion, arise, as, except in few instances, rice is grown in more or less saturated rather than submerged soils. This is due to the fact that irrigation being nowhere practiced, and the rainfall being intermittent and comparatively light, submergence is only occasional and of short duration. Even after heavy or prolonged rains, few fields remain submerged for more than a few days. On the contrary, it is not uncommon during a normal season for the soil to become dry. It may be said therefore that the majority of our crops are grown under conditions alternating between wet and dry.

3. Further, as only one crop is grown yearly, the rice lands are fallowed for several months during which very little rain falls and the soil cracks and dries up to a depth of two or more feet. And again, before being planted, all rice areas are twice ploughed and harrowed, never puddled, except occasional small plots, and the crops during the early stage of their growth are hoe-weeded once or twice.

4. Under such conditions, so favourable to aeration by natural and cultural processes, and in the absence of the very conditions—puddled soils and prolonged submergence—for which drainage is recommended, the necessity for draining our rice fields to promote aeration does not seem to arise. Moreover, the bulk of the present rice fields are so small and widely separated that any scheme for their drainage would involve an expenditure much in excess of any good (problematical) that might result from it.

5. *Aeration of rice fields condemned.*—It is interesting to note, however, that while the recommendations of the Department of Agriculture, United Provinces, favour the aeration of rice fields that are to be submerged, W. P. Kelley in *Fertilisation and Management of Rice Soils*, Hawaii Agricultural Experimental Station, condemns the practice on the grounds that:—

(*a*) Nitrates which are formed in the soil following aeration are broken down (denitrified) under submergence, into largely, nitrites which are toxic to rice, and that;

(*b*) nitrate as a form of combined nitrogen is ill-suited to assimilation by rice, in fact it is unsuited to its nutrition.

6. Kelley contends that the one condition that is most obviously different in rice (wet) soils and dry lands is that of aeration. The fact, he says, that aeration is essential to the successful growth of most crops, and the belief that fertility is in some way dependent upon its maintenance, has caused agriculturists to recommend for rice soils practices designed to secure aeration in the belief that this is as essential for rice culture as for culture of other crops. Experiments, he declares, are not wanting, however, which show this to be untrue. In fact, Kelley's experiments indicate quite conclusively that for the most successful production of rice all conditions which tend toward aeration should be avoided.

7. *Nitrate unsuitable to rice.*—Regarding the denitrification of nitrates under submergence into nitrites which are poisonous to rice, and the practical non-availability of nitrogen in the combined form of nitrate to rice, Kelley is just as emphatic as he is on the question of aeration. He is supported in the former by Nagaoka, Japan, while other experimenters are in agreement with him on the latter. In a series of pot experiments both Kelley, Hawaii, and Colman and Ramchandra Rao, India, found that where nitrate was the only form of combined nitrogen present rice made very poor growth. The net result of all these, and a number of other experiments, to quote Kelley, forces the conclusion that nitrate is not a suitable form of nitrogen for rice. He is not, however, without opponents on this question.

8. The latest experiments on the *Availability of Nitrogenous Fertilizers to Rice* by R. P. Bartholomew, Assistant Agronomist, University of Arkansas, have just been published in *Soil Science*, Vol. XXVIII, No. 2. Like other investigators whose experiments are contrary to Kelley and his supporters' findings on the low nutritive value of nitrate to rice, Bartholomew concludes that it is safer owing to the uncertain behaviour of nitrates under anærobic conditions, to recommend highly the use of organic forms of nitrogen, or the use of ammonium compounds, such as ammonium sulphate or ammonium phosphate.

9. Such evidence, the result of extensive and careful experiments, is not only opposed to the principle underlying the recommendations made by the Department of Agriculture, United Provinces, but has a direct bearing on rice culture in this Colony, for even if denitrification of nitrates into nitrites does not take place to an undesirable (toxic) extent, the considerable amount of nitrates which must result from the natural and cultural conditions facilitating aeration in our rice fields would appear to be, at the best, of little manurial value to our crops. This point I wish to strongly emphasise, as my experience in rice culture is that crops and yields depend almost directly on the percentage of organic matter in the soil. To this fact, in my opinion, is due the marked decrease in yields of our rice crops.

10. *Lack of organic matter in Fiji rice fields.*—As long as our rice lands were new and rich in organic matter, ammonification took place and the rice plant was provided with nitrogen in the form most suited to its nutrition—ammonia. Now, however, that those lands have been cropped for many years, without either the application of ammonical manures or the ploughing in of organic matter, this source of nutrition has been greatly reduced and the yields of the crops are 20 per cent to 30 per cent less than when these lands were new, or comparatively so. There are still a few small good yielding areas but even on these the yield has declined.

11. *Serious defects in local rice culture.*—Throughout the Colony the custom when reaping rice crops is with very few exceptions, to cut the plants 4 to 6 inches above the ground and to carry away the straws with the heads attached, to a convenient place where they are heaped for hand threshing sooner or later, according to weather conditions. To an acre of ground, one or two of such heaps are formed, usually on the same sites each year, and after threshing the straws are either left to rot or are burnt in the heaps, or as is more often the case, are partly or wholly removed for house-thatching or for use in other ways, in which case they are never returned to any part of the land. Excepting near to a grower's home, where the land is higher and the soil more friable, no nitrogenous crops are grown for the improvement of the soil. Even when grown in small plots near to a house, the crops of beans are for commercial purposes or home consumption; so that except for the short rice stubbles and a crop of weeds, which are ploughed into the land when preparing for the next crop several months after the rice has been cut, nine tenths of the land, or the whole of it if the straws are removed or burnt in heaps, receives no organic matter to keep up or increase the supply of it in the soil for its mechanical improvement or for the provision of the rice plant's most nutritious food—ammonia.

12. This lamentable state of affairs does not obtain in rice culture only but it is very general, though to a lesser extent, in other agricultural industries in the Colony, except cane growing by the Colonial Sugar Refining Company Limited who pay particular attention to the inprovement of the soil, both by mechanical and manurial means. Lands producing commercial crops such as coconuts, rubber, cotton, bananas, maize, &c., are generally never helped with leguminous fertilizers either ploughed into the soil or as cover crops. The cultural practices of the majority of the planting community other than Indians, leave much to be desired and those of the Indian settlers outside the cane areas are of a slip-shod style and a "trust in God" for results. To return to rice, this practice has been going on for years and will continue to do so unless steps are taken to teach the Indian rice growers the value and use of organic matter in the soil. Any precipitate or direct attempt, however, to attain this desideratum will meet with resentment rather than response, for the reason that the

use of rice straws for house thatching and other purposes is as essential to the rice grower as cane leaves are to the cane grower and swamp grass is to the native, for like purposes. The case, however, can be met satisfactorily, but not without much endurance and teaching.

13. *Nitrogenous Manures.*—Authorities on rice culture throughout the world, as a result of many experiments, are in accord on the matter of ammonia, as sulphate of ammonia or in nitrogen form in legumes, being the most nutritive food for rice. While sulphate of ammonia yields the best results, it is costly and I fear beyond the means and reach of the Indian rice growers. Legumes, on the contrary, though perhaps less effective, are well within the means of the Indians and forming a part of their diet, their cultivation is understood by them. The legumes grown for manurial purposes, principally by the Sugar Company, are Mauritius bean (*Stizolobium aterrimum*) rice bean (*Phaseolus calcaratus*) and cowpea (*Vigna catjang*), while those grown by Indians for food purpose are pigeon pea (*Cajanus indicus*) urd (*Phaseolus mungo*) mung (*Phaseolus radiatus*), &c., &c. There are also several varieties growing wild, among which is the rattlepod (*Crotalaria saltiana* ?) which should possess a high content of nitrogen and grows on every kind of soil. Clovers have been tried on many occasions without success. Other legumes have lately been introduced but are not yet established. Further varieties should be imported, more particularly quick growing ones to cover the ground before weeds have time to spring up. The Sugar Companies would welcome any variety that would answer this purpose. The soy bean (*Glycine hispida*) varieties, especially, should be tried because of the great demand for these beans in the world's markets. From such a stock to pick from, one or more varieties can be selected for growing as nitrogenous fertilizers to the rice fields but especial attention should be paid to the *Crotolaria* owing to its high nitrogen content, the ease with which it grows on all kinds of soil and the fact that it is unpalatable to cattle, who do such damage among other legumes.

14. (i) Seed selection, (ii) treatment of paddy between cutting and threshing operations, and (iii) propagation of approved varieties call for special attention. The first is hardly ever practiced and accounts in some measure for the decrease in yield; the second is responsible for the cracking and yellowing of the grain, while the third, due to the Indian's conservatism and his preference for certain varieties for home consumption, is not making sufficient headway in spite of the higher prices offered for the better varieties for commercial purpose.

SOME FEEDING EXPERIMENTS UNDERTAKEN IN TRINIDAD WITH LIOTHRIPS URICHI (KARNY).

By W. Cook, B.A., (Cantab.)

INTRODUCTION.

Clidemia hirta, D. Don, belongs to the order Melastomaceæ, and occurs in Fiji (having been introduced) as a serious agricultural pest.

It occurs in Trinidad, generally distributed over the island, and is of no importance agriculturally, as it is always found with definite plant associations, and is generally attacked by *Liothrips urichi*.

As the Fiji Government have a proposal under consideration to introduce this thrips into Fiji for the control of *Clidemia hirta*, some indication of its feeding adaptabilities was thought necessary. The Fiji Government

applied to the Imperial College of Tropical Agricluture Trinidad for some feeding experiments to be carried out, and the writer received this problem from the Principal as part of his work during the academic year 1928-1929.

METHODS AND OBSERVATIONS.

Each intended host plant was tried four times; twice with thrips in their first and second larval stages, and twice with an equal proportion of male and female adults. Controls were effected by placing thrips, in the stages corresponding to those placed on the crop plant, on small plants of *Clidemia hirta* in pots, and keeping them under exactly the same conditions as those on the crop plant.

Two controls were used for each different crop plant, one for the adults and one for the larvæ.

Various methods were tried for introducing the thrips on to the leaves of the plant. The method that gave the most satisfaction was by means of a blunt bent " seeker " for the adults, while for the smaller larvæ a thin two inch black entomological pin was employed. The pin or " seeker " was gently placed underneath the thrips as it was stationery. feeding on the leaf. It was then transferred to the leaves of the crop plant by gently brushing the end together with the adhering thrips on the surface of the leaf until the thrips became detached from the instrument and adhered to the plant. After some practice the thrips were transferred in this manner without any damage to them.

A camel's hair brush did not raise the thrips effectively from the *Clidemia*, as the hairs were pushed aside by those on the leaves of the plant.

As in the case of the controls the crop plants were grown in, or transferred to, pots and were infected while still young.

Coconut, cocoa, and hevea seedlings were used, while the breadnut, the seeded variety of the breadfruit, was used instead of the latter. Sugar cane, sweet potatoes and cassava were propagated from cuttings, while the bananas were taken from the sword suckers of the varieties concerned. Taros and yams were grown from rhizomes.

There is no bean grown in Trinidad known as the Rice bean, so the Soya-bean (*Glycine max.*) which is grown under experimental conditions on the college farm, was used instead. Also *Paspalum virgatum*, a coarse vigorous grass, was tried instead of *Paspalum dilatatum*, as the latter is not recorded from the island.

Two methods, each depending upon the nature of the crop plant, were employed for keeping the thrips in confinement, once they were introduced.

For the larger plants a sleeve of strong muslin was used, the mesh of which, while permitting free aeration to the plant, was small enough to prevent the thrips from escaping. The sleeve, open at both ends, was placed around the branch or leaves to be infected, or in the case of the smaller plants, *e.g.*, cassava, around the main stem. A wad of cotton wool was wound around the stem, the base of the sleeve placed round it, and a second wad of cotton wool wound over this, and tied firmly with twine. The thrips were then introduced, and the top of the sleeve tied up securely around a cotton wool plug. In cases where it was necessary, the sleeves were supported by means of stakes stuck in the pot. This method was most satisfactory, as it prevented the escape of the thrips, and did not damage the plant in any way or interfere with its photosynthetic processes.

In the second method, used for the smaller plants, *i.e.*, cocoa seedlings *Mimosa pudica*, groundnut, rice, &c., the leaf or leaves to be infected were enclosed in a small glass far, about two inches in diameter and six inches

long. The jar was fixed to a stake stuck in the soil of the pot, the jar tied at such an angle that the part of the plant to be enclosed entered it without any forced bending or strain.

After the thrips were introduced, a muslin square of the same type as was used in the previous method, was tied around the open end, enclosing the stem or leaf petiole. This was accomplished by cutting up the middle of one side of the muslin to the centre, and enclosing the two separate flaps around the stem. These were then drawn together one over the other, so that the remaining slit was obliterated, and the whole tied and gummed firmly to the neck of the jar. A small wad of cotton wool was gummed around the stem at its point of entrance through the muslin.

This method was also satisfactory in that if properly done, it prevented the escape of the thrips, and at the same time did not interfere with the photosynthesis of the plant.

The plants under experiment were kept from strong sunlight in an insectory with open sides. They were examined regularly, and opened when all the adults were dead, or when all the larvæ had either died or pupated. The controls of course were kept under exactly similar conditions to the corresponding crop plants.

As it was not found possible to breed sufficiently large colonies of thrips on *Clidemia* in pots, for the purposes of infection, *Clidemia* was collected from the bush, and from this material the thrips were taken and placed on the experimental plants. Recently emerged adults were used for the adult infections, and males and females were placed on the leaves in approximately equal proportions.

The number of thrips introduced depended on the amount of the food plant made available for them, or the sizes of the plant if wholly infected, a reasonably heavy infection being aimed at in each case. In their natural condition in Trinidad, never more than twenty-five thrips occur together under one leaf, or the petiole and stem adjoining it, the average number being far below this.

When introducing the thrips to the crop plants their natural position on the *Clidemia* was copied as far as possible; that is they were placed on the lower side of the younger leaves wherever this could be effected. In many cases they ran agitatedly up and down the leaves, with their tubes curled up over their backs in a characteristic manner, often crawling down the stem and on to the side of the sleeve or jar. In some cases this behaviour was continued for two or three days.

Those few larvæ which pupated often did so in the folds of the sleeve at its lower end, or on the muslin net, where it passed over the neck of the jar. In many cases the pupæ were small and abortive and died before moulting to adults. Only in the case of tobacco and *Paspalum virgatum*, where rather advanced larvæ had been introduced, were some pupæ successful in coming through to the adult stage.

At the conclusion of each experiment the leaves of the crop plant were examined carefully for any sign of damage that might have been done by the thrips. Only in the case of sugar cane, maize and groundnut, could any marks be discerned that might have been made by the attempted feeding of the thrips, and these were of such small dimensions as to be of negligible importance.

These marks took the form of small brown scarifications, on the upper surfaces of the leaves, and were only observed in the experiments with larvæ on the three crop plants concerned. In all other cases the thrips did absolutely no damage to the crop plants concerned.

After the conclusion of each experiment with adults, the leaves and other parts of the plant exposed to the thrips were very carefully examined under the binocular microscope. In no cases were any eggs of the thrips found. The great majority of the dead bodies of the thrips were found in the sleeve or on the sides of the jar, only in a few instances were any to be seen on the leaves.

The controls were examined at the end of each experiment and in every case the thrips put on them were alive and healthy. Many of the larvæ had pupated, and eggs were laid on the underside of the top leaves in every case on controls infected with adults.

RESULTS.

The results are best summarized in the two following tables, one for the larvæ (Table I) and the other for the adults (Table II).

TABLE I.

INFECTIONS CARRIED OUT ON TWO PLANTS A AND B.

(Average day temp., 84° F.; night, 74° F.)

Material.		Number of thrips.	Date of infection	Date of last examination.	Interval of infection.	Remarks.	Control.
					days		
Coconut*	A	50	Feb. 4	Feb. 8	4	All dead	Healthy.
	B	60	Feb. 8	Feb. 13	5	All dead	Healthy.
Sugar cane	A	30	Jan. 29	Feb. 2	4	All dead	Healthy.
	B	30	Jan. 29	Feb. 2	4	All dead	Healthy.
Bananas*—							
Gros Michael	A	60	Mar. 8	Mar. 14	6	All dead	Healthy.
	B	50	Mar. 12	Mar. 18	6	1 pupated. Remainder dead. Pupa dead March 24.	Healthy.
Cavendish	A	30	April 24	May 1	7	All dead	Healthy.
	B	30	April 24	May 1	7	1 pupated. Remainder dead.	Healthy.
Pineapple*	A	25	Mar. 5	Mar. 14	9	All dead	Healthy.
	B	25	Mar. 5	Mar. 11	6	1 pupated. Remainder dead.	Healthy.
Cotton	A	25	Jan. 26	Jan. 30	4	All dead	Healthy.
	B	25	Jan. 26	Jan. 31	5	All dead. One dead pupa.	Healthy.
Mauritius bean	A	25	Feb. 28	Mar. 7	7	1 pupated. Remainder dead.	Healthy.
Bengal Bean (*Stizolobium deeringianum*)	B	25	Feb. 28	Mar 5	5	All dead	Healthy.
Soy Bean* (*Glycine max*)	A	25	May 25	June 7	10	All dead	Healthy.
	B	25	May 25	June 7	10	All dead	Healthy.
Breadnut*	A	30	May 7	May 17	10	All dead	Healthy.
	B	30	May 7	May 17	10	1 pupated. Remainder dead.	Healthy.

* Infected by sleeve method.

TABLE I—*continued.*

Material.		Number of thrips	Date of infection	Date of last examination.	Interval of infection.	Remarks.	Control.
					days		
Sweet Potato	A	25	Jan. 24	Jan. 28	4	1 prepupa dead Jan. 30. Remainder dead	Healthy.
	B	25	Jan. 24	Jan. 28	4	All dead	Healthy.
Taro*	A	25	Feb. 21	Feb. 26	5	All dead	Healthy.
	B	25	Feb. 21	Feb. 26	5	All dead	Healthy.
Tobacco* (first expt.) ...	A	50	May 11	May 22	11	3 newly formed adults Remainder dead. Newly formed adults dead May 31. No eggs on leaf.	Healthy.
	B	50	May 11	May 22	11	2 newly formed adults Remainder dead. Adults dead May 30. No eggs on leaf.	Healthy.
Tobacco* (second expt.)	A	50	May 27	June 7	11	2 newly formed adults in A. 1 newly adult in B. Remainder dead. Newly formed adults dead June 11. No. eggs on leaf.	Healthy.
Yam*	A	25	April 26	May 6	10	1 pupated. Remainder dead	Healthy.
	B	25	May 7	May 17	10	All dead	Healthy.
Para Grass (*Panicum muticum*).	A	25	Feb. 14	Feb. 18	4	All dead	Healthy.
	B	25	Feb. 12	Feb. 16	4	All dead. One dead prepupa.	Healthy.
*Paspalum Virgatum**	A	30	June 8	June 21	13	2 newly formed adults in A. Two newly adults in B. Remainder dead. Adults dead June 24. No eggs on leaf.	Healthy.
	B	30	June 8	June 21	13		Healthy.
Rice	A	25	Feb. 19	Feb 23	4	All dead	Healthy.
	B	25	Feb. 19	Feb. 23	4	All dead	Healthy.
Dhal* (Pigeon Pea) (*Cajamus indicus*	A	25	Feb . 25	Mar. 1	4	All dead	Healthy.
	B	50	Mar. 2	Mar. 7	5	All dead	Healthy.
Groundnut	A	25	Feb. 27	Mar 5	6	1 pupa. Remainder dead. Pupa dead March 8	Healthy.
	B	25	Feb. 27	Mar. 5	6	All dead	Healthy.
Cocoa	A	25	Feb. 16	Feb. 21	5	1 prepupa Remainder dead. Prepupa pupated Feb. 22. Dead Feb. 24.	Healthy.
	B	25	Feb. 16	Feb. 21	5	All dead	Healthy.

* Infected by sleeve method.

TABLE I—*continued.*

Material.	Number of thrips.	Date of infection	Date of last examination.	Interval of infection.	Remarks.	Control.
				days		
Para Rubber* ..... A	30	May 7	May 17	10	2 pupated. Remainder dead.	Healthy.
B	50	May 8	May 17	9	All dead	Healthy.
(Tapioca) Cassava (*Manihot utilissima*) ..... A	25	Jan. 30	Feb 4	5	All dead	Healthy.
B	25	Jan. 31	Feb. 9	9	All dead	Healthy.
Mimosa pudica ..... A	25	Mar. 16	Mar. 21	5	1 pupated. Remainder dead. Pupa died March 27.	Healthy.
B	25	Mar. 18	Mar. 25	7	All dead	Healthy.
Maize..... A	25	Feb. 9	Feb 15	6	All dead	Healthy.
B	25	Feb. 4	Feb. 9	5	All dead	Healthy.

TABLE II.

INFECTIONS CARRIED OUT ON TWO PLANTS A AND B.

(Average day temp., 84° F; night, 74° F.)

Material.	Number of thrips.	Date of infection	Date of last examination.	Interval of infection.	Remarks.	Control.
				days		
Coconuts* ..... A	15	April 5	April 15	10	All dead	Healthy,
B	15	April 6	April 15	9	All dead	a few eggs.
Sugar cane* ..... A	15	April 17	April 24	7	All dead	Healthy,
B	15	April 17	April 24	7	All dead	eggs.
Bananas*—						
Gros Michael ..... A	15	Mar. 26	April 4	9	All dead	Healthy,
B	15	Mar 28	April 6	9	All dead	eggs.
Cavendish ..... A	15	April 16	April 22	6	All dead	Healthy,
B	15	April 16	April 22	6	All dead	eggs.
Cotton* ..... A	15	April 23	May 1	8	All dead	Healthy,
B	15	April 23	May 1	8	All dead	eggs.
Bengal Bean ..... A	10	Mar. 23	Mar. 30	7	All dead	Healthy,
B	10	Mar. 23	April 2	10	All dead	eggs.
Soy Bean* ..... A	10	May 27	June 7	11	All dead	Healthy,
B	10	May 27	June 7	11	All dead	eggs.
Breadnut* ..... A	15	May 8	May 17	9	All dead	Healthy,
B	15	May 8	May 19	11	All dead	eggs.
Sweet Potato ..... A	10	April 8	April 16	8	All dead	Healthy,
B	10	April 23	May 1	8	All dead	eggs.

* Infected by sleeve method.

TABLE II—*continued.*

Material.		Number of thrips.	Date of infection	Date of last examination.	Interval of infection.	Remarks.	Control.
					days		
Taro*	A	12	Mar. 25	April 4	10	All dead	Healthy, eggs.
	B	10	April 5	April 15	10	All dead	
Tobacco*	A	10	May 13	May 22	9	All dead	Healthy, eggs.
	B	10	May 13	May 22	9	All dead	
Yam*	A	15	April 26	May 6	10	All dead	Healthy, eggs.
	B	15	April 26	May 6	10	All dead	
Para Grass (*Panicum muticum*)	A	10	May 2	May 11	9	All dead	Healthy, eggs.
	B	10	May 2	May 11	9	All dead	
Paspalum virgatum	A	15	June 10	June 21	11	All dead	Healthy, eggs.
	B	15	June 10	June 21	11	All dead	
Rice	A	10	April 25	May 3	8	All dead	Healthy, eggs.
	B	10	April 25	May 5	10	All dead	
Dhal* (Pigeon Pea) (*Cajanus indicus*)	A	10	Mar. 15	Mar. 20	5	All dead	Healthy, eggs.
	B	10	April 6	April 15	9	All dead	
Groundnut	A	10	Mar. 19	Mar. 24	5	All dead	Healthy, eggs and young larvae.
	B	10	Mar. 19	April 2	14	All dead	
Cocoa	A	10	Mar. 20	Mar 27	7	All dead	Healthy, eggs.
	B	10	Mar. 20	Mar 28	8	All dead	
Para Rubber*	A	15	May 9	May 21	12	All dead	Healthy, eggs.
	B	15	May 9	May 17	8	All dead	
Cassava (Tapioca)*	A	12	April 20	April 29	9	All dead	Healthy, eggs.
	B	12	April 20	April 29	9	All dead	
Mimosa pudica	A	10	May 14	May 24	10	All dead	Healthy, eggs
	B	10	May 14	May 24	10	All dead	
Maize*	A	12	May 10	May 20	10	All dead	Healthy, eggs.
	B	12	May 10	May 20	10	All dead	
Pineapple*	A	12	April 27	May 6	9	All dead	Healthy, eggs.
	B	15	April 27	May 6	9	All dead	

* Infected by means of sleeve.

It will be seen that all the larvæ died between four and thirteen days, those in the first instar dying sooner than those in the second. The interval for tobacco and *Paspalum virgatum* was longer than the rest as advanced larvæ were introduced, and the experiments were carried through until the newly formed adults were dead. In the case of tobacco the experiments were repeated with similar results.

All the adults died between five and fourteen days, the length of the latter in the case of one of the groundnut experiments, was due to one female which outlived the others by five days.

On none of the crops under trial were the females induced to lay eggs, but eggs were invariably laid on the corresponding controls.

CONCLUSIONS.

Since no eggs were laid on those plants infected with adults, ~~that~~ all adults died without doing any damage to the crop plants concerned, and that only previously well-fed larvæ pupated on them, it can safely be said that *Liothrips urichi* does not show any signs of adapting itself, either in the larval or adult stages, to any of the crop plants tried in the above experiments.

Those larvæ introduced just before their normal time of pupation, pupate on the crop plant and come through to the adult stage, but these die without laying eggs or feeding (*e.g.*, tobacco, *Paspalum virgatum*).

Prepupæ and pupæ, as non-feeding stages of the thrips can give rise to adults when placed on plants foreign to it, but adults and larvæ, *i.e.*, the feeding stages of the thrips, cannot exist on any plant other than *Clidemia hirta*.

Thus it seems that *Liothrips urichi* is specific with regard to its food plant *Clidemia hirta*, and would not attack any other plant in Fiji if introduced.

ACKNOWLEDGMENTS.

The writer's thanks are due to Mr. F. W. Urich for many helpful suggestions, and to Mr. A. Pickles for kindly criticism.

SOME NOTES ON PLANT ASSOCIATES AND HABITAT OF CLIDEMIA HIRTA (D. DON) IN TRINIDAD.

By W. Cook, B.A. (Cantab.).

Clidemia hirta is a Melastomaceous shrub 4–12 feet high. It occurs throughout Jamaica, St. Kitts, St. Vincent, Trinidad, Venezuela, *i.e.*, its range is from Cuba and Mexico to Brazil and Peru.

It is very common in Trinidad, where it seldom exceeds five feet, and occurs in shady situations and on the edge of forests. In that island also the shrub is very generally attacked by *Liothrips urichi*, Karny, and it was during a study of these insects that the writer's attention was drawn to the habitat of the plant.

Clidemia hirta appears to prefer light shade, and it was never observed growing out in the open by itself, or invading cultivated areas exposed to sunlight. Typically, the plant occurs in two main habitats, both resulting from operations by man. A typical plant association including *Clidemia hirta* is seen where land previously cleared of virgin forest is left to lie idle, or where a previously cleaned, cultivated region is allowed to revert to bush. This association takes the form of vigorous bushes, and the land is completely covered by these, interspersed with a few trees.

The main bushes in order of importance are given in the following list:—*

Cordia cylindristachya, R.S. (black sage).
Lantana camara, L. (wild sage).
Psidium guava, Rudd. (the guava shrub).
Eupatorium cinereum, Gr. (a species of Christmas bush).
Gonzalea spicata, D.C.
Genipa americana, L.
Securidaca erecta, L.
Casearia ramiflora, V.

* See footnote to page 93.

Some bushes of *Eupatorium odoratum*, L. are generally to be found on the edges. Throughout this mass of bushes, scattered trees, generally a mixture of *Cecropia palmata*, W. *Acrocomia sclerocarpa*, Mart. (gru-gru palm) and a few *Mangifera indica*, are seen. *Clidemia hirta* is always found mixed with these bushes, generally as small shrubs, and taking the advantage of the shade caused by them. It is constantly associated in this environment with *Clidemia dentata*, D. Don, a shrub with pinkish leaves, and *Clidemia neglecta*, D. Don. These two species are always more vigorous than *Clidemia hirta*, when they occur together.

In these associations, which were observed on numerous occasions, the *Clidemia hirta* seemed to be kept down to small proportions by the overgrowth of the vigorous bushes of *Cordia cylindristachya*, *Lantana camara*, and *Eupatorium cinereum*, which would first strike the eye. The general attack of the thrips of course causes additional stunting.

The other marked habitat in which *Clidemia hirta* always occurs is along the banks of traces which are cut through cocoa plantations, generally on those winding up the mountains. It is very seldom found on narrow traces through original forest land, and it is never seen in the original forest itself. The plant along the sides of the bank are often cut low by cutlassing, but whenever they are allowed to grow *Clidemia hirta* is seen together with its plant associates. A typical bank of such a trace would contain the following flora.—Along the top there is generally a mixture of Miconias, chiefly *Miconia virescens*, *Triana*, and *Miconia acidodendron*, Sweet, together with species of Centropogon, and scattered species of Olyra grass.

In more exposed positions the tops of the bank are covered with *Eupatorium cinereum*. *Clidemia hirta* is always prominent along the sides, but it is never very large. It very seldom reaches more then three feet, and quite often is only a small plant. The following plants are its chief associates in this habitat:—*

Gonzalea spicata.
Clidemia dentata.
Stachytarpheta cayennensis, W.
Borreria laevis, *Gr.*
Borreria bartilngiana D.C.
Piper marginatum, Facq.
Solanum trichocarpum, Miq. .....
Coccocypselum nummularifolium, Cham. Schl.
Wulffia stenoglossa, D.C.

These plants would be found growing with ferns consisting of species of Hemitelia and Blechnum.

These two main habitats of *Clidemia hirta* were noted as a result of a few months empirical observation while collecting thrips.

In Trinidad *Clidemia hirta* is almost always seen in these two habitats. In the first it is relatively insignificant as compared with its other associates, and in the second it never grows to a large bush. Thus in that island it is of no importance agriculturally as a weed.

The writer is deeply indebted to Mr. W. Broadway of Trinidad who very kindly identified the plants named in the above notes.

* The above lists are not intended to be a complete list of plants that would be found in those particular habitats, only those are mentioned which are constantly seen occurring with *Chidemia hirta.*

COCONUT NOTES.

(From *Tropical Agriculture*, Vol. VI, No. 10.)

THE FLORAL BIOLOGY OF THE PALM.

THE advantages to be obtained from the use of planting material of known parentage, and the difficulties of obtaining such in the case of the coconut palm, have led several workers to investigate the sequence of events in the flowering of this crop, and the biology of its pollen, in the hope of establishing some practicable methods of controlling fertilization.

The latest contribution to the subject seen is an article by Maréchal (6) which adds some interesting details for Fiji to those previously published in Ceylon (5) the Philippine Islands (1), and Malaya (2), (3).

EXPERIMENTS IN FIJI.

Maréchal (*loc. cit.*) used palms of the Malayan Dwarf coconut (introduced to Fiji), the Fijian Dwarf or *Niu Leka*, and the *Rotuma* variety. The Malayan Dwarf appears from his observations to behave in Fiji very much as it does in Malaya according to Jack and Sands (3). That is to say that the male phase of the inflorescence overlaps the female, and was never observed to end before the female phase began, so that natural self-pollination is possible in this variety. Maréchal, however, thinks on the basis of his experiments that self pollination is not the rule in Fiji, whereas Jack and Sands are definitely of opinion that in Malaya it is the rule. In the other varieties under observation the male phase was always found to finish from one to five days before the female phase began, and there was never sufficient overlapping of successive inflorescences to permit any self-pollination.

The period from the opening of the spathe until the first female flowers were receptive was found to vary from nine to thirty-two days in *Niu Leka* and from five to twenty-three days in Malayan Dwarfs.

Extensive tests were made of the viability of pollen under different conditions of storage, and a convenient method of pollen collection is described. Of the various media used for germinating the pollen to test its viability, the most satisfactory was 25 per cent. sucrose solution with 4·5 per cent. gelatine. The best storage results were obtained by keeping the pollen in full light in a desiccator over sulphuric acid of 30 to 40 per cent. strength. Under these conditions from 35 per cent. to 60 per cent. of the grains retained their vitality for at least 16 days.

Maréchal claims that one of his experiments demonstrated that "coconut pollen requires light to keep alive, and full daylight at that." This can hardly be taken on the published figures as well-founded without further proof. Pollen is capricious material to handle at all times, and safe generalisations about its behaviour can only be drawn from long series of experiments.

On the question of natural pollination, Maréchal agrees with other workers that both wind and insects play a part, but regards bees as by so far the most important pollinating agents as to be essential for high production of nuts.

It is not clear from the tables of results of pollinations that any controlled selfing with stored pollen was actually done, but artificial crosses were made with successes averaging about 30 per cent. and the technique used is described.

EXPERIMENTS IN TRINIDAD.

During the Session 1927–28, H. A. Pieris, a post-graduate student, carried out in the Botanical Department of the Imperial College of Tropical Agriculture a series of pollen tests similar to those of Aldaba (1), Furtado (2), and Maréchal. The number of palms available for the work at the time was small, and the results, embodied in a Dissertation presented for the Associateship of the College, were not published. It now appears, however, that observations in Trinidad may be of wider interest for comparison with those in Fiji and elsewhere, and the following short account has been compiled from the Dissertation in the College Library in order to make them available.

The trees used were a group of eight, about nine years old, and of the common Trinidad kind. Pieris found that the interval between the opening of one spathe and the opening of the next varied from 25 to 37 days. The interval from opening of the spathe to receptivity of the first female flowers was from 19 to 24 days, and no case was observed of an inflorescence opening before the female phase of the preceding one was over, or of any overlapping of male and female phases in the same spadix. Cross-pollination is therefore apparently the rule in Trinidad.

To assess the relative importance of the natural pollinating agents, Pieris made an attempt to separate the effects of wind, crawling insects (red and black ants were the chief crawling insects noted on trees), and flying insects. The flying insects observed in inflorescences were *Apis mellifica*, *Polistes annulatus*, *Musca domestica*, and a small black beetle. These were easily excluded by bagging emasculated inflorescences with a rather wide-meshed muslin, which would not interfere seriously with wind-borne pollen, but the separation of wind and small crawling insects such as ants is less easy, and the method adopted, viz.: bagging with a very fine muslin bag tied loosely round the bottom of the spadix, cannot be claimed to be satisfactory, as wind-borne pollen was probably not entirely excluded.

Nevertheless, the results are of some interest. In waxed bags all flowers shed in a few days, but the dark, humid conditions inside the bags may have been as much responsible as the complete exclusion of pollen. In fine-meshed bags ten flowers set nuts out of 156 enclosed, or six per cent.; from general observations it is concluded that these were probably due to imperfect exclusion of wind-borne pollen, and not to ants. In coarse-meshed bags, out of 70 flowers enclosed, 22 set nuts, or 31 per cent. When emasculated inflorescences were left freely exposed, 42 flowers out of 108 set nuts, or 39 per cent.

Pieris concludes that wind pollination can only be as effective as it evidently was in this experiment, at fairly close quarters. This opinion he confirmed by repeating an experiment of Aldaba's, and exposing vaselined plates in different positions to catch wind-borne pollen. A plate exposed in the axil of a leaf on a tree adjacent to one which was shedding pollen at the time caught a few grains (the exact number is not stated) but in a second case where the source of pollen was two trees away, only three or four grains were collected in four days.

Fresh pollen was observed to contain a certain proportion of small and irregular grains, varying in different samples from 4 per cent. to 26 per cent. This agrees with Aldaba's findings, of abortive grains in proportions ranging from 3 per cent. to 33 per cent. in all the cultures he made. It may prove on further investigation to be a point of some importance.

The medium used by Pieris for germinating pollen as a test of viability was a sucrose solution made up freshly for each series of experiments, boiled

to sterilize it, and cooled before use. This was employed in hanging drop cultures. The opitimum concentration was 25 per cent.—giving usually over 80 per cent. germination, with 20 per cent, and 30 per cent. sucrose not greatly inferior. As high a germination percentage as 14 per cent. was obtained in a 5 per cent. solution, showing that coconut pollen is fairly tolerant in its requirements.

Comparisons made between pollen stored over clacium chloride in a desiccator and pollen stored in gelatine capsules indicated that whilst the loss of visability after eight days was considerable in both cases, it was less in the gelatine capsules than in the desiccator. The best germination percentages on the eighth day were 49 per cent. for " capsule " pollen and 22 per cent. for " desiccator." After this, however, the capsule pollen rapidly deteriorated, and gave germination (7 per cent. only) in only one set of experiments out of eight on the 16th day, and none at all on subsequent dates. Desiccator pollen, on the other hand, although rather erratic, continued to give small percentages of germination until the 31st day. The best samples gave 34 per cent. on the 16th day, 15 per cent. on the 18th day, 9 per cent. on the 27th day, and 4 per cent. on the 31st day.

Artificial pollinations were carried out both with fresh pollen and with stored pollen. Fresh pollen set six nuts from 38 flowers pollinated, pollen kept seven days in a gelatine capsule set two nuts from 11 flowers, and pollen kept seven days in a desiccator set three nuts from 14 flowers. These numbers are admittedly small, and it is unfortunate that it was not possible at the time to test pollen stored for longer intervals, but the figures are quoted because in the third case mentioned the three nuts were set with pollen from the same inflorescence, collected before the male flowers shed. The possibility of artificial selfing of coconuts in Trinidad was thus definitely established.

GENERAL CONSIDERATIONS.

As there are now several accounts of the floral biology of the coconut palm in different parts of the Tropics available for comparison, it may be useful if a short summary is given here of the state of knowledge to date.

Production of inflorescences.—The average rate of spadix production is sometimes stated to be about one per month, and this may perhaps be used as a rough rule, but there is so much variability that a general average based on several sets of observations in different places can be of little value.

The shortest average interval between successive inflorescences yet recorded is 20 days, for dwarf coconuts in Malay (5), and it would be interesting to to know whether this variety is genetically different from tall kinds in this respect, but there is no record available of any comparisons between the two types under similar conditions. In an earlier paper (3) based on observations of a different set of dwarf palms (which, by the way, are described as " not well cared for ") the same authors give a table from which the average interval works out at 24 days, and this is not significantly different from the average interval of 25 days calculable from one of Aldaba's tables for two tall palms in the Philippines.

Such difference in behaviour between two sets of palms of the same variety may fairly be adduced as evidence of a general effect of environmental conditions, and perhaps even stronger evidence is afforded by the remarkable variations in interval exhibited by any single palm in the course of a few months. Petch (8) for example, observing one palm at Peradeniya, found intervals ranging from 24 to 58 days. This example is selected from many available because Petch notes that the longest interval occurred in the driest months, whilst the month of the shortest interval (May) is usually

hot and moist at Peradeniya. He adds, however, that in general the intervals are not governed only by rainfall.

The relationship of spadix production to general growth conditions does not appear to have been anywhere worked out in detail, but from the observations of Mason and Lewin on the Oil Palm in Nigeria (7) and from consideration of the fact that there is normally a spadix in every leaf axil, we should expect the rate of flower-bud formation to be determined by the same factors as the rate of leaf formation, whilst the later development and opening of the inflorescence are likely to be governed by additional factors.

Number of female flowers per spadix.—All investigators report wide variability in this character, Furtado putting the extremes at zero and three hundred, whilst Sampson (10) records having counted up to 235. No data have been found which show how much of this variation is due to genetic differences between palms, but the evidence for seasonal fluctuation is abundant.

Maréchal records a tendency for Malayan dwarf coconuts in Fiji to produce more female flowers in the inflorescences which open from November to March than in those opening during the rest of the year, and there are similar notes in other papers. The most detailed record is that of Sampson, who gives a graph showing very definite seasonal fluctuation on the Malabar Coast of India, and suggests a correlation with climatic conditions which in broad outline is probably correct. More detailed work still, based on an exact determination of the length of time which it takes for the bud to develop from its first initiation, would probably disclose some interesting features of the physiology of the palm, with an obvious bearing on the question of final yield.

Percentage of flowers forming mature nuts.—This probably depends upon three sets of factors, viz.: (1) the genetic constitution of individual trees (2) the conditions governing pollination and (3) the general condition of the trees at the time.

So far as the first set of factors is concerned, we know from the work of Jack (4) that individual palms possess an inherent capacity for high, low or medium bearing, and it seems reasonable to suppose that inherent capacity for high, low or medium setting of fruit may be one of the causes contributing to final yield, but we have no information more definite than a statement by Sampson to the effect that some trees never produce a large number of female flowers, but at the same time set a high proportion of them, with the result that cropping is relatively steady, whilst other trees are very irregular in bearing.

The general condition of the tree, and its relationship to the fall of immature nuts after these have been properly pollinated, does not properly belong to our subject, and the conditions governing pollination demand a separate heading.

Conditions governing pollination.—The question of prime importance to the coconut breeder, and one which has been widely discussed, is whether the palm is normally self- or cross-pollinated. This question may be simplified at the outset by removing from the discussion the dwarf coconut of Malaya, which has been shown fairly conclusively by Jack and Sands to be chiefly self-fertilized in Malaya, and by Maréchal to have at least the potentiality of considerable natural selfing in Fiji.

From the sum of observations on other types, it is quite clear that cross-pollination is the general rule, but opinion still varies about the amount of self-pollination that may take place. In some localities the latter method appears to be entirely ruled out, whilst in others the case is different. Self-pollination, when it does occur, may result from overlapping of the male and female phases of the same spadix, or, probably more commonly, from overlapping of the female phase of one spadix with the male phase of the next on the same tree. The points of importance therefore are the interval between inflorescences, the onset and duration of the male phase, and the onset and duration of the female phase. The indications are that each of these is affected by environmental conditions. Warmth and humidity appear to accelerate the onset of the phases, perhaps especially the female phase, so that in the lowlands of Malaya, for example, this phase may begin before the male ends. On the other hand, a lower humidity favours the retention of vitality by the pollen, so that there may sometimes be the possibility of female flowers being fertilized by pollen from male flowers of the same inflorescence which have already dropped.

Accepting cross-pollination as the rule, we come next to the question of the pollinating agents. Here there is general agreement that both wind and insects play a part, and that wind is only effective at fairly short range. Further, there is a striking similarity between the lists of insects observed visiting the flowers in different parts of the world. All observers place bees at the head of the list in importance and add other Hymenoptera; nearly all report the common house-fly or a closely allied species, and several add at least one species of beetle but assign little importance to it.

Artificial pollinations.—From what has been said, it will be evident that any attempt to control the parentage of seed nuts must involve protection of the flowers against foreign pollen. This means that the spadix must be emasculated and bagged, and a bag which safely excludes all possibility of contamination by wind-borne pollen may be rather unfavourable to the setting of nuts. Possibly this accounts for the rather poor results obtained by some workers with artificial pollination. Apart from this, there is no difficulty in making crosses if the desired pollen is available, but if self-pollinations are required, or if the right pollen for a cross is not available at the right time, recourse must be had to storage.

Keeping qualities of pollen.—Taking the results of all investigators together, it is clear that under some conditions coconut pollen will keep for about a week without any special precautions. The length of its life, however, may be greatly increased and rendered more certain by controlling the humidity of the atmosphere, which is probably the most important factor. In an atmosphere saturated with moisture, the grains, lose their viability in a few hours, whilst at the other extreme of humidity the majority lose their viability over calcium chloride rather faster than undesiccated grains, though a few remain alive for at least a month. The optimum condition lies between the two, and the best results for practical purposes are those of Maréchal, who, as mentioned above, obtained germinations of 35 per cent. to 60 per cent. after sixteen days by storing over 35 per cent. sulphuric acid.

Pollen culture.—Even under careful conditions of storage, pollen will always vary and it is therefore necessary to test samples before use. This can be done by germinating the grains in a sucrose solution; and the optimum concentration has been found by several to be 25 per cent. although germination is obtained in all concentrations from 5 per cent. to 30 per cent.

In conclusion, it may be stated that the best results to date, whilst serving immediate practical purposes, are sufficiently irregular to indicate a need for still further investigation of the biology of coconut pollen.

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SOIL EROSION.

(From *The Empire Cotton Growing Review*, Vol. VI, No. 4.)

A VERY interesting address upon the development of tropical countries was delivered at the annual meeting of the Empire Cotton Growing Corporation by Mr. Stockdale, the Assistant Agricultural Adviser of the Colonial Office. His observations were of such importance in their bearing upon the future of our tropical and sub-tropical Empire that they should be closely studied by all who hope that that future will be full of steady progress and prosperity.

Among the important subjects which were brought up in the address, and with which we may perhaps deal at various times, was that of soil erosion, which plays a larger role than is always clearly understood. People who have not seen the rain fall in the tropics, especially in the monsoon countries that include so large a part of the Empire, are apt to picture it as something like the rain at "home." Our rain, however, except upon rare occasions, would be regarded there as gentle drizzle.

If in England one clears a piece of land, the rain undoubtedly begins to wash it away, and to leach it, but at a rate that is hardly worth mentioning beside that which occurs in the tropics. There, a shower in which a whole month's English rain falls in a few hours is a common occurrence, and we have ourselves seen 10 inches of rain fall without a break in less than a day. Such rain rapidly washes away the surface soil, and leaches out the lower layers, so that in a few years after clearance the richest forest land may be reduced to the poorest possible condition.

The natural state of most of the land in the rainy countries of the tropics is to be covered with forest or coarse grass. In either case it is useless for general agriculture, but its soil is at the maximum degree of content of humus, plant food and water-retaining capacity (largely due to the humus) that occurs under natural conditions. These features—which, as everyone who works with agriculture in the tropics knows, soon diminish and largely disappear after clearance of the land—are the natural capital of the country. This capital should be conserved, not regarded—whether consciously or unconsciously—as something to be exploited until perhaps the land at the last must be abandoned (as one may see in many places). The real question is, how to get the best out of the land without destroying the natural capital more than can be helped.

It is possible to live almost entirely upon the capital value of forest land, and this is the underlying explanation of the type of cultivation known in Ceylon as chena, in India as jhuming, in Malaya as ladang, and by other names in other countries. It is found almost all over the world where population is thin enough to allow to each person a large area of forest land. The trees on a portion of this are felled and burnt, and on the rich forest soil, further improved by the ash, a couple of crops of cereals or other products are grown, and the land is then left to go back gradually to forest: it is again good enough to chena in ten to fifty years.

This is living upon capital purely and simply, for the land is abandoned as soon as it begins to become weedy, in order to avoid the labour of real cultivation. It is less trouble to chena a fresh piece of land. If population increase, however, as it has done for example in much of India and Ceylon, chena must perforce be given up and more real clutivation carried on. But this has, in such countries, to be done upon land where the natural capital, owing to reckless clearance, has been very much reduced. The result is poor and uncertain crops, varying considerably with the climate of the particular year.

In districts where the people are more intelligent, or perhaps, to be more exact, where pressure of population has compelled them to take more care, one may see attempts being made to rectify this state of things, by green manuring, rotation of crops, mixture of crops, and even by the use of actual manures, though, in general, cowdung, which is almost the only available and cheap manure, is used as fuel, and so is largely lost. But there are distinct and recognizable attempts to put back something into the soil, or to equalize and minimize its rate of loss.

A state of things which is essentially very similar to this may be seen in most tropical regions opened up by Europeans in coffee, tea, &c. Largely through ignorance, they have used up the natural capital of soil, humus, &c., almost as rapidly as possible. Their planting of various crops has largely proceeded in " booms," in which there has been an insistent demand for land, and not sufficient foresight or knowledge on the part of the Government to curb this demand in the interests of future generations.

The result has been wholesale opening of land, usually in hilly country, where erosion proceeds more rapidly. The heavy rainfall has caused tremendous erosion and leaching, and has led to the silting up of rivers, causing floods and stoppage of navigation. A heavy price has frequently to be paid by a country that has been opened up for planting—not so much at the time, as later, when results of the mistakes that were made in earlier times begin to appear.

Just as with the native industries above mentioned, so the planting industry has been forced to resort to the use of manures, of green manures, of terracing to prevent wash, of drainage, and so on. But the Government can and should also assist, for example, by the provision of sufficient reserves of forest. In Ceylon, in early days, small strips of forest were left along the tops of the ridges, but they were so narrow that they were soon consumed for firewood, burnt, of otherwise rendered nugatory. However insistent be the demand for land, the Government should enforce the reservation of large areas in forest, in such a way as to prevent erosion (so far as possible), or the drying up of the streams in hot and dry weather, a common occurrence in such countries as Ceylon, where it adds greatly to the difficulties of water supply.

The provision of an officer for general service in the tropical and sub-tropical colonies, to deal with this whole question of prevention of erosion

and of deterioration of soil, is quite worth the consideration of Government. But if appointed, he should spend a good deal of time in study both within and outside of the Empire, to see how the matter is dealt with, for example, in Java by terracing, &c., in China and Japan by the use of manure, &c., and in other countries in other ways. He should establish liaison with forest and irrigation officers, with engineers in charge of roadmaking, and others, and eventually with their assistance devise definite schemes for road, drainage, and forest reservations, and for all such matters which concern several departments (and which must therefore be carried out by definite orders from Government headquarters), in addition to working at the questions of manuring, green manuring, &c., which are the province of an agricultural department.

Nearly all countries which have been opened up for any kind of "planting" afford striking object lessons in what ought *not* to be done, and the newer colonies should profit by these lessons before it is too late, and should learn what *ought* to be done, and do it.

FULL SCOPE FOR AGRICULTURAL IMPLEMENTS AND MACHINERY.

(From *The Implement and Machinery Review, Oct.*, 1, 1929.)

When every rood of ground maintained its man.—Goldsmith.

It is quite clear in "The Deserted Village" Oliver Goldsmith was trying to point the moral of what has since been the substance of most "back-to-the-land" movements. Intensive tillage of the land by manual labour, with every rood worked to the uttermost, may have been an ideal in the days of long ago, but nowadays the idea that men have only to return to the land in great numbers and work it most laboriously to be successful and to restore the economic equilibrium of the country, is being rapidly exploded. Two recent Canadian references on that point come most opportunely, as it is convincingly shown in both of them that to parcel out the country into so many "cabbage patches"—a term of disparagement that is permissible because it is so aptly expressive—is, under present conditions, most retrogressive. Intensive hand labour, which is the *sine qua non* of the successful working of any small holding, is the most expensive form of performing farm operations, and current tendencies are all in the direction of showing that, far from it being necessary to place greater or increased dependence on hand labour, the demands of the times are that less and less assistance of this class shall be required. Hand labour everywhere is dearer than mechanical work when the latter is afforded full scope for application, and therefore it is held to be the negation of all progress to suggest, as has been suggested in some quarters, that the ideal would be to carve up all the big estates and holdings and hand them over to various individual workers for more intensive cultivation. But that suggestion we can briefly dismiss as the ideal of a certain school of political faith. The ideal from an agricultural point of view is that the less hand labour there is required for a specific operation, the more likely are costs going to be cut, and that is why there is a decided leaning to-day, even in this country, (England) towards larger farms and freer use of modern implements and machinery, with the bigger outfits looked upon with greater favour if their acquisition is justified by the size of the estate. We know of several farmers who are contemplating important steps in this direction, in which case a rood of ground will not maintain a man in the sense of our quotation, but will be merely a small factor in a comprehensive whole. Indeed, the

temper of much farming opinion which we have come in contact with lately, is that farms are already too restricted without any question of further parcelling out, and that it is time some of the hedges and other natural and unnatural dividing lines between field and field were swept away to give full play to the labour saving implements and machines now available. The feeling is ably expressed by a correspondent to *The Times*, when dealing with the subject from another angle, viz, that of farming in Canada. "It is," he says, "an elementary economic fact that the overseas farmer competes successfully with the European farmer simply because he can work on extensive and not intensive lines," and to show that this is no mere play upon words, the same authority remarks that a Canadian farmer can make a profit out of a 20-bushel crop when the English farmer cannot do so with one of 30 bushels. The explanation, as is confirmed by a Bulletin prepared by Mr. W. C. Hooper (of the Central Experiment Farm, Ottawa), and published by the Dominion Department of Agriculture, is that "on of the important means of reducing the cost of producing crops, and thereby enlarging the profits from farm enterprise, is to increase the daily amount of work performed per farm worker." And this can only be done, we believe, by the efficient application of modern farm implements and machinery.

HOW THE USE OF IMPLEMENTS AND MACHINERY BECOMES MORE ECONOMICAL.

For when was power beneficial in vain ?—Johnson.

To appreciate the truth of the argument in favour of implements and machinery working land intensively and cheaply against the old and effete system of sweating man power, it is only necessary to call one or two instances from the report published by the Canadian authorities. It is shown, as a case in point, that whereas a one-furrow plough hauled by two horses and guided by one man can plough something like 1·33 acres of sod or 1·58 acres of stubble daily, a tractor and a three-furrow plough requiring one more man-power, can cover 6·85 and 7·73 acres in the respective categories. These are the two extremes given in this official report, for a two-furrow plough and tractor outfit returns 4·81 and 5·51 respectively, which strengthens the argument in favour of the most intensive use of mechanical outfits in their highest form of expression. As ploughing is acknowledged to be the most expensive operation in the preparation of land for seeding, the exact outcome of the substitution of modern methods for the older ones can be readily estimated if not precisely measured. The same remarks apply in the case of other classes of work. Two horses with a single disc harrow cover 7·47 acres per day, and with a double disc, 6·18. Compared with this a tractor of what is termed three-plough capacity can cover 20·37 and 19·93 acres respectively. Harrowing and land rolling with two horses are given at 11·47 and 13·79 acres respectively, whereas, it is well known that such work with tractors exceeds these returns by really extraordinary margins. Nor must it be overlooked that the experiments of the Canadian authorities have established that in planting, harvesting and kindred operations, the application of the best mechanical means has proved to be the most advantageous, particularly in the direction of economy. Any talk, therefore, of cutting up large estates and dividing them out, while doubtless very solacing to certain political individuals, cannot be justified on the evidence of the day, for what has been proved to apply in Canada is being daily found to be applicable to all countries where labour charges are shown

to be a severe burden at a time when the actual rate of pay for labour is as low as decency will tolerate. The remedy, therefore, is to make labour more profitable by applying it differently, *i.e.*, with the aid of more machinery, and once that is done intelligently, agriculture everywhere will not have such a cadaverous appearance.

EFFECT OF METALS ON MILK.

(From *Queensland Agricultural Journal*, Oct. 1, 1929.)

An interesting and important paper on the effect of various metals on milk and milk products by Professor Hunziker was read in the course of the recent World's Dairy Congress week in London.

The investigations involved a study of the resistance to corrosion of nineteen different metals—plated metals and metallic alloys—to the action of sweet and sour milk and cream; of the individual organic acid contained in milk and cream; of numerous washing-powders and chemical sterilisers; and of sodium and calcium brine. The investigation included the effect of these metals on the flavour and physical properties of the milk and milk products. The following conclusions have been arrived at as a result of the investigations:—

1. Zinc, iron, galvanised iron, and copper proved utterly unsuitable metals for dairy factory equipment. They not only corroded profusely, but developed in the milk product objectionable flavours with unfailing regularity. These off-flavours were chiefly of the metallic flavour character. These tests emphasise the fact that much of the metallic cream that arrives at the creameries is due to rusty cream cans, and that the preservation of the tin coating on the inside of the can is an exceedingly important factor in controlling the quality of the cream.

2. Nickel silver, Monel metal, and poorly-tinned iron also injured the flavour of the milk, though the flavour defect was not so pronounced, and the loss in weight due to corrosion, while considerable, was not as great as in the case of the metals under Group 1. These metals are unsafe for use in the construction of milk plant and creamery equipment. Monel metal proved somewhat more resistant to corrosion and less damaging to the milk product than nickel silver.

3. The ordinary chromium steels, such as Ascoloy and Enduro, and also aluminum and aluminum manganese alloy, proved quite resistant to corrosion, and in most cases harmless to the milk product. Ascoloy and Enduro, however, while resistant under most conditions up to a certain point, pitted and rusted freely under severe conditions. Enduro showed somewhat greater resistance than Ascoloy. This suggests that these ordinary chromium steels are not safe alloys to use in dairy factory equipment.

Pure aluminum had no appreciable effect on any of the milk products excepting very sour milk, such as acidophilus milk, in which it developed a slightly metallic flavour. Likewise, its resistance to corrosion, excepting in the presence of alkalies, was generally good. The greatest weakness of aluminum is its high corrosiveness in contact with alkalies, such as are contained in the washing-powders and in alkaline brine. In the case of sodium carbonate and sodium brine, the resistance of aluminum may be very greatly augmented by the addition of a small amount of sodium silicate. Aluminum is being used advantageously in European factories for milk storage tanks and milk shipping cans.

4. Nickel, tin, and properly tinned copper carried no noticeable off-flavour in the milk product, and their loss in weight due to corrosion was comparatively small. These metals, while also slightly soluble in lactic acid, may be considered safe metals for use in milk plant and creamery equipment as far as their effect on the flavour of the milk product is concerned. The tin proved more nearly completely inert than the nickel, which tarnished readily and caused a slight off-flavour in acidophilus milk.

5. Allegheny metal, which is a special chromium-nickel-steel alloy, proved superior to any of the other metals studied. It had no effect on the flavour of any and all milk products, and it suffered no loss in weight, and showed no visible signs of corrosion in organic acids, sweet and sour milk and cream, alkaline washing powders, and brines. This alloy promises to play an important role in the construction of our future dairy equipment.

6. The presence of two or more metals in the same piece of dairy equipment is fundamentally undesirable. Most metals used may differ in their electrical potentials, and this in turn invites corrosion and impairment of flavour by electrolysis. For similar reasons impurities in metals, as for instance, impure aluminum, such as cast aluminum, also copper alloys and imperfectly tinned iron and copper, are equally unsatisfactory.

CONTROL OF WEEDS ON LAWNS.

(From *Queensland Agricultural Journal*, Oct. 1, 1929.)

WEEDS in lawns and on bowling and golf greens cause considerable annoyance and trouble, and are often difficult to control, especially if proper precautions have not been taken from the outset. As a rule, most trouble is experienced on lawns and greens which have not been properly drained, or which are shaded, or where the soil has not been enriched before laying down the grasses. It is obvious, therefore, that control of weeds in such places must be kept in view from the time that the lawns are being established.

In the case of bowling-greens and golf greens special care should be exercised to see that they receive direct sunlight throughout the whole of the day, particularly during the winter months, and also that they are thoroughly drained by means of agricultural drain pipes placed below the ground. The soil should also be enriched either by adding a better class of soil or by heavy dressings of well-rotted animal manure. If these precautions are adopted and high-grade seed, free from weed seed, is sown thickly, little trouble will be experienced from weeds. Subsequently, a vigorous growth of the grass should be encouraged by frequent watering and by top-dressing with well-rotted animal manure composted with soil.

When such dressings are being made, care should be exercised to see that all weed seeds have been destroyed in the compost. This can only be done by composing the soil and manure in heaps which can be kept under observation for some months. If it is not possible to ensure that the composts are free from weed seed, it is preferable to use artificial fertilisers for top-dressing.

Despite the greatest care that is taken, however, weeds will occasionally appear in lawns, and they must be immediately hand-pulled. If care is exercised in this direction, no great difficulty will be experienced in keeping the weeds under control. Clover is often troublesome in lawns, and this can be checked to some extent by top-dressing with sulphate of ammonia, which does not encourage the growth of clover, but stimulates the growth of grass, which checks the clover.

Superphosphate and lime should not be used on lawns which are likely to be infested with clover, as they stimulate the growth of clover.

Chemical exterminators cannot be recommended to any extent for control of weeds on lawns, but they can be used, particularly arsenic preparations, for killing individual plants such as paspalum grass. A little of the preparation should be dropped on the middle of the plant.

FIJI LIVESTOCK RECORD ASSOCIATION.

MINUTES OF SPECIAL GENERAL MEETING HELD ON OCTOBER 15, 1929.

THE following were present:—Superintendent of Agriculture, Acting Senior Veterinary Officer, Hon. A. Barker, Messrs. J. L. Hunt, G. Kiss, J. Barber, R. Barber, A. H. Witherow, L. N. Bean, R. Craig, A. S. MacKenzie, J. A. Garnett and A. B. Ackland.

The Superintendent of Agriculture stated that he had called the meeting with a view to re-forming the Association, which had ceased to function, and that, if the meeting decided that a Livestock Record Association was necessary, he would do everything in his power to make such an Assocation a success. He appealed for the support of all stock owners. The gentlemen present signified their approval of the objects of the meeting.

The minutes of the inaugural meeting of the Association and of a meeting of the Directors, held on the 7th September, 1927, were read by the Secretary who outlined the action taken thereunder.

A motion, "That the Fiji Livestock Record Association to be re-formed as from to-day," proposed by Mr Barker and seconded by Mr J. L. Hunt, was carried unanimously.

It was resolved that the meeting be regarded as the first General Meeting of the re-formed Association.

Mr. Barker proposed and Mr. Witherow seconded a resolution that the subscriptions be remitted for the balance of the year 1929, but that, as soon as the subscription rates had been decided upon and approved, the Secretary should proceed to collect them in respect of the year 1930.

The Superintendent of Agriculture appointed Mr. A. B. Ackland to be Honorary Secretary of the Association.

The following gentlemen were elected by ballot to be Directors of the Association:—G. Kiss, Esq., R. Craig, Esq., and J. Barber, Esq.

The meeting then considered certain matters with a view to indicating to the Directors the wishes of the members.

It was decided to recommend the Directors to take action as follows:—

(*a*) To seek approval for the use of the *Agricultural Journal* as the official organ of the Association, in which would be published the Rules. The Superintendent of Agriculture said that amendments to rules, owners and names of animals registered (without pedigrees) and reports of meetings, could be printed from time to time. A list of members and the Annual Report of the Association would be printed once a year. The journal might also be used for advertisements at standard rates of stock for sale and sires available for service.

(*b*) To amend the Regulations so as to provide for the payment of fees on the following scale:—

Subscriptions.

Life membership	£5	5	0
Annual membership	0	10	0

Fees for Registration, &c.

Members—			
First male	0	5	0
First female	0	3	0
All subsequent registrations, each	0	1	0
Transfers, each	0	2	6
Prefix or suffix, each	0	5	0
Regulations, &c.	0	1	0
Non-members—			
Male animals, each	0	5	0
Female animals, each	0	3	0
Transfers, each	0	2	6
Prefix or suffix, each	0	5	0
Regulations, &c.	0	1	0

(*c*) To amend Regulation 35 so as to provide for the exemption from the provisions of that Regulation of all stock imported prior to the 31st December, 1929.

Mr. Stuchbery stated that Sir Henry Scott and Messrs. D. Costello and G. C. Foulis had signified their intention of becoming members of the Association.

Mr. Witherow referred to the practice of all Friesian Associations of requiring photographs of animals to accompany applications for registration. The meeting decided that the Regulations should include provision for this procedure.

FIJI LIVE STOCK ASSOCIATION.

MINUTES OF MEETING OF BOARD OF DIRECTORS HELD ON OCTOBER 24, 1929.

THE following were present:—Superintendent of Agriculture, (Chairman), Acting Senior Veterinary Officer and Messrs. R. Craig, J. Barber and G. Kiss.

Amendments to Regulations.—The Board directed that the Government should be requested to amend the Regulations made under the Live Stock Record Association Ordinance, 1927.

Branding of Cattle.—After some consideration of Regulations 42 and 47, which refer to the branding of animals registered in the Herd Book, it was decided not to make any amendment to these Regulations.

Seal of the Association.—The Chairman was authorised to procure a rubber stamp to serve as a Seal as provided for in Regulation 27.

Association's Brand.—The Board directed that the brand of the Association should be ⌐⌐ provided that such Brand was not already registered. The Secretary was instructed to register the Association's Brand under the Brands Ordinance 1927. The Board further directed that owners of stock should be permitted to brand registered animals on such conspicuous parts of the body as they should desire.

Date of Annual Meeting.—The date of the Annual General Meeting was fixed for the sixteenth day of January, 1930.

Enrolment of Members.—The Secretary was instructed to approach stock owners in regard to joining the Association, as soon as the proposed amendments to the Regulations had been made.

FIJI LIVE STOCK RECORD ASSOCIATION.

REGULATIONS.

1. The constitution and regulations of the Association shall be as follows:—

NAME.

2. The Association shall be "The Fiji Live Stock Record Association."

OBJECTS.

3. The objects of the Association shall be—
   (*a*) to keep a record of the pedigrees of pure bred domestic animals of distinct breeds;
   (*b*) to collect preserve and publish data information and documents relating to pure bred domestic animals; and
   (*c*) to encourage the breeding of pure bred domestic animals in whatsoever way the Association may see fit to do.

MEMBERS.

4. There shall be three classes of members:—

(*a*) *Honorary Members.*

The Association at a general meeting may appoint honorary members but such honorary members shall take no part in the management of the Association's affairs. Provided however that honorary members may take part in the proceedings at a general meeting and vote thereat if a majority of all other members present so decide by resolution and provided further that such honorary members had been appointed at the time notice was given calling the said meeting.

(*b*) *Life Members.*

Life members shall be those resident in the Colony who have paid a fee of £5 5s.

(*c*) *Annual Members.*

Annual members shall be those persons partnerships or incorporated companies resident in the Colony who pay an annual membership fee of 10s. on or before the thirty-first day of January in each year in advance. Persons resident outside the Colony may become life or annual members of the Association provided their applications are approved by the Board.

5. Applications for membership shall be in writing and each applicant shall agree to be bound by the constitution and amendments and all regulations of the Association.

6. All members shall as a matter of contract and except as hereinafter provided enjoy the same rights and privileges and be subject to the same liabilities as if each had signed the application for incorporation of this Association or this constitution as amended from time to time. No member who is in arrears for membership or other fees or dues shall enjoy such rights and privileges.

7. Any member may provided he is not in arrears for membership or other fees or dues at any time withdraw from and terminate his membership in the Association by giving the secretary one month's notice in writing of his intention so to do.

8. If any member shall be in arrears for membership or other fees or dues for a period of six months the Board may terminate his membership

in the Association by resolution a notice of which shall be mailed to him at his last known post office address as on record in the books of the Association but any member whose membership is so terminated shall not again become a member unless arrears owing at time membership was terminated are paid.

9. Each member of the Association shall receive free of charge publications which are issued during each year of his membership for which he has paid the membership fee.

10. No member shall hold office or be entitled to vote at a meeting if at the time he is in arrears for membership fees and no member shall be entitled to vote who was not a member of the Association at the time notice was given calling such meeting.

11. The Board shall have power to suspend any member who fails to observe any regulation of the Association or whose conduct in their opinion is prejudicial to the Association. Such suspension shall be reported to the next general meeting and the Association may by the affirmative vote of a majority of those present at a general meeting expel such member from the Association.

12. No person expelled shall thereafter be eligible for membership until his reinstatement has been recommended to a general meeting by the Board and such general meeting shall reinstate such member only by the affirmative vote of two-thirds of the members present and voting thereat.

13. Any person expelled from membership of any other association for the improvement of pure bred domestic animals shall be ineligible for membership in this Association and if he is a member at the time of such expulsion his membership shall thereupon forthwith terminate automatically.

OFFICES.

14. The head office of the Association and the office for the registration of pedigrees shall be at the office of the Superintendent of Agriculture in Suva.

FISCAL YEAR.

15. The fiscal year of the Association shall correspond with the calendar year.

OFFICERS.

16. There shall be a Board of Directors of the Association of whom the Superintendent of Agriculture shall be chairman and the Government Veterinary Officer nominated by the Governor an *ex officio* member. In addition there shall be elected by ballot at the first general meeting of the Association three directors to hold office during two years who shall be eligible for re-election at the end of the same period of two years when a fresh election shall be held at a general meeting and in like manner every two years. The Secretary shall also act as treasurer and registrar of the Association. He shall attend all meetings of the Association or the directors and keep minutes of the proceedings. He shall conduct all head office correspondence and prepare reports. He shall give notice of all meetings of the directors of the Association receive all moneys of the Association and deposit the same in a Bank in Suva and pay the same out again by cheque counter-signed by the Superintendent of Agriculture. He shall keep proper books of account and shall keep the pedigree register of the Association and enter therein all pedigrees and transfers in such form as may be determined upon and perform any other work or duties in connection with the Association as may be determined by the Board.

PEDIGREE COMMITTEE.

17. The Chairman and the Government Veterinary Officer serving on the Board shall form a pedigree committee who shall have power to adjudicate all questions of transfer of ownership or eligibility for registration. Their decision in so far as the records of the Association are concerned shall be final but shall not affect any other right or liability in a court of law.

AUDITOR.

18. The Association at each annual general meeting shall appoint an auditor and fix his remuneration. His duties shall be to examine the books of account of the Association vouchers for all payments and present a report thereon at the next annual general meeting.

MEETINGS.

19. There shall be held an annual general meeting at such place and time as may be fixed by the Board. Notice by letter posted to each member's last known address shall be despatched at least thirty days before the date of such meeting.

20. The Board shall meet at least once in every three months at such time and place as the Chairman shall direct. Notice shall be given to the directors by letter despatched at least ten days before the date of such meeting.

21. A meeting of the Board may be held on shorter notice with the consent of a majority of the directors.

22. For the transaction of the business of the Association at an annual or other meeting a quorum shall be seven. At a meeting of the Board a quorum shall be three.

AUDIT.

23. The Board at each annual meeting shall submit a complete report of its acts and of the affairs of the Association; it shall present a detailed statement duly audited of the receipts and payments of the preceding year and of the assets and liabilities of the Association.

RECEIPTS AND PAYMENTS.

24. The income and property of the Association from whatever source derived shall be applied solely toward the promotion and furtherance of the objects of the Association and no part thereof shall be paid or transferred directly or indirectly by way of bonus or otherwise as profit or gain to members past present or future of the Association or any person claiming through any member; provided however that nothing herein contained shall prevent the *bona fide* payment of remuneration to any secretary treasurer registrar editor officer clerk servant or other person or persons for services actually rendered to the Association whether such are members of the Association or not and the expenses of directors or other officers incurred in performing the business of the Association.

BOOKS.

25. The secretary shall keep at the head office of the Association a book wherein shall be printed a copy of the constitution and regulations of the Association and a list of the members. A copy of such book shall be supplied to every member of the Association upon his first joining the Association free of charge and subsequently on application and on payment of a fee of one shilling.

REGISTRATION AND MEMBERSHIP FEES.

26. All fees shall be paid in cash to the Secretary and shall forthwith be deposited by him to the credit of the Association in a Bank arranged with by the Board.

CORPORATE SEAL.

27. The Association shall have and use, as occasion may require, a Seal or Stamp as may be decided upon by the Board.

REGISTRATION OF PEDIGREES.

28. A register shall be kept at the office of the Association. This register shall be known as " The Fiji Stud Book " and shall contain a copy of the constitution and may be consulted by any member at any time.

29. There shall be delivered to every person recording an animal a certificate of registration in such form as may be decided by the Board.

30. Herd books shall be published at such time and in such form as may be decided by the Board.

31. Any person expelled from membership shall not be allowed the privilege of recording pedigrees on the register of the Association.

32. Any member in arrears of membership fees shall not be allowed the privilege of recording pedigrees on the books of the Association.

33. The Board shall have power for any cause which in the opinion of the Board seems proper to suspend any member or refuse applications for registration or transfer from any person whether a member or not pending action by the Board or a general meeting of the Association.

ENTRY REGULATIONS.

34. In order to qualify for registration in the Fiji Stud Book animals must be the direct progeny of registered animals on both sire's and dam's side.

35. In the case of imported animals application for registration must be accompanied by official pedigree export and transfer certificates and be entered in the Stud Book of their respective breed in the country of origin. The provision of this Regulation shall not apply to animals imported prior to the first day of January, 1930, provided that application for registration of such animals must be accompanied by evidence to the satisfaction of the Board of the pure breeding of such animals.

36. In the case of animals bred in Fiji application for registration must be accompanied by a sworn declaration from the breeder as to its breeding. Such registration shall not be complete until the animal has been inspected and approved by a Government Veterinary Officer.

36A. Application for registrations of animals of the Friesian breed of cattle must be accompanied by certified photographs of such animals.

37. Animals the progeny of sire and dam already registered in the Fiji Stud Book will be accepted for registration on the sworn declaration of the breeder after the animal has been inspected and approved by a Government Veterinary Officer.

38. Application for registration of an animal sired outside Fiji but born in Fiji the progeny of an imported stud animal must be accompanied by a certificate of service signed by the owner of the sire. The provisions of this Regulation shall not apply to any animal sired outside Fiji but born in Fiji the progeny of a stud animal imported prior to the first day of January, 1930, provided that application for registration of such animal must be accompanied by evidence to the satisfaction of the Board of the pure breeding of such animal.

39. In the application for registration of any animal the Herd Book number of sire and dam must be given.

40. All applications for registration &c., of horses and cattle must be made on the correct forms issued for the purpose. Any form not correctly filled in will be returned to the applicant for completion. No application will be considered unless accompanied by the fee prescribed.

41. Official forms will be as follows—

(*a*) application for registration form;
(*b*) transfer certificate, original and duplicate;
(*c*) extended pedigree certificate;
(*d*) certificate of service;
(*e*) form of monthly notification of births in herd;
(*f*) form of notification of deaths in herd;
(*g*) export certificate.

42. All animals born in Fiji must be branded by the breeder before registration or sale and in addition must bear either a fire brand on the skin or a tatoo mark in the left ear indicating the herd number of the animal. This should be done in the following manner. Irrespective of age or sex beginning with 1. Each animal will be numbered consecutively in the order of its birth. The registered brand and herd number must be shown on the form when the application for registration is made and on any transfer certificate.

43. The breeder of any animal must register the animal before any transfer by him can be recorded.

44. The vendor is responsible for the compulsory registration of transfer and payment of transfer fees. Application for registration of a transfer not received within three months of such transfer shall be specially considered and if deemed necessary a fine for delay may be imposed. The official form must be used in all cases of transfer.

45. The Fiji Stud Book will be published yearly and all applications for entry must be lodged not later than the thirtieth day of June in each year.

46. If an inaccuracy or omission be discovered relating to any entry or if an entry shall prove to have been wrongly or incorrectly made such entry shall be cancelled by the Board and the Fiji Stud Book amended accordingly.

47. All animals born in Fiji when registered shall be branded with the Association's mark.

FEES.

48. The following fees shall be charged—

Life membership	£5 5 0
Annual membership	0 10 0
Registration of transfer	0 2 6
Registration of prefix or suffix to name	0 5 0
For book of Regulations and list of members	0 1 0
Registration of Animals—	
Members of the Association—	
For the first male	0 5 0
For the first female	0 3 0
All subsequent registrations, each	0 1 0
Non-members of the Association—	
Male animals, each	0 5 0
Female animals, each	0 3 0

CONTENTS.

PAGE

EDITORIAL 79

Original Articles—

SOME ASPECTS OF RICE CULTIVATION IN FIJI *by J. P. Tarby* .. 82

SOME FEEDING EXPERIMENTS UNDERTAKEN IN TRINIDAD WITH LIOTHRIPS URICHI *by W. Cook, B.A. (Cantab.)* 85

SOME NOTES ON PLANT ASSOCIATES AND HABITAT OF CLIDEMIA HIRTA (D. DON) IN TRINIDAD *by W. Cook, B.A. (Cantab.)* .. 92

Selected Articles—

COCONUT NOTES—THE FLORAL BIOLOGY OF THE PALM 94

SOIL EROSION 99

FULL SCOPE FOR AGRICULTURAL IMPLEMENTS AND MACHINERY.. 101

EFFECT OF METALS ON MILK 103

CONTROL OF WEEDS ON LAWNS 104

FIJI LIVE STOCK RECORD ASSOCIATION—

Minutes of Meetings 105

Regulations 107